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Modern measurement techniques for testing advanced military communications and radars

"The Value of Vector, concepts and capabilities of a vector signal generation"
Vector signal generation provides an easy to use, cost effective, off-the-shelf solution to the signal simulation requirements for radar and communications systems and their components.

"Creation of frequency agile and custom waveforms for advanced military communications and radar applications"
High-fidelity real-world waveforms are critical for development of the next-generation military communications and radars. The ability to build and play a variety of real-world wideband and frequency agile waveforms is now possible using the N6030A and MATLAB®.

"Coherent Multi-Channel Systems Test Technology"
Coherent multi-channel systems have unique properties that enable beam forming, direction finding and improved reception in a dispersive channel. Agilent provides the specialized test solutions necessary for these coherent multiple port applications

"Advanced Test Techniques for Software Defined Radios"
The ability to design, simulate, analyze, and emulate the performance of military software defined radios has become increasingly important for complex wideband systems. Agilent provides tools to make model-based measurements achievable for complex wideband systems.

"Scalable Radar Target Generation and Analysis Systems"
Often custom test hardware for radar systems rivals the complexity of the radar being tested. Learn how to simplify the design of a radar test system by using modern test system tools to proto-type the basic building blocks of a multi-mode radar.

"Digital Baseband and Digital IF--Signal Analysis and Signal Generation Techniques"
Designers developing tomorrow's communications and radar systems frequently use mixed analog and digital/DSP techniques at baseband and IF frequencies. Agilent provides advanced, flexible and easy-to-use tools for testing at baseband and IF frequencies.

"Future Proofing Your Automated Test System Using LAN-based Synthetic Instruments"
The military spends billions of dollars annually on automated test equipment to maintain military hardware. The support costs associated with this test equipment is equally staggering. Synthetic instruments are building blocks for "future proof" automated test systems that are smaller in size, achieve lower total cost of ownership, and are easily reconfigured. Agilent provides synthetic instruments that can be used to build cost-effective automated test systems to test a wide variety of military electronic systems.

"Advances in Converter Test"
Agilent provides modern vector network analyzers that employ advanced vector-error-correction techniques to make highly accurate magnitude, phase, and group delay measurements of frequency-translating devices like mixers and up/down converters.

"High Speed Spectral Survey Techniques for Frequency Monitoring and Technical Security Applications"
Understand the fundamental measurement challenges in RF spectral survey, RF technical security and other frequency monitoring applications. Agilent provides a measurement platform optimized for speed and automation for these applications.

"New techniques for increasing the POI in intercept and collection of LPI push-to-talk voice communications." (US only)
This paper will describe and demonstrate a new intercept system that dramatically increases the probability of intercept for push-to-talk voice communications.

"RF Spectrum Monitoring and Geolocation Techniques Using Distributed Sensor Networks"
RF Emitters using low signal-to-noise ratio formats such as spread spectrum (e.g. CDMA) can be hard to detect and locate. Agilent now has technology under development that will soon provide improved spectrum monitoring and accurate geolocation of such RF emitters.

The Value of Vector: Concepts and Capabilities of Vector Signal Generation

Author(s): John Hansen (tn 577-4721)

Length: 50 minutes with demonstration

Abstract:

Outside the creation of waveforms for testing the physical layer of digital communication systems, vector or I/Q signal generation has been used mostly in the most advanced stages of development for aerospace & defense systems and components. Vector waveform simulation has been reserved for late in the system development cycle when final evaluation and characterization of the fully integrated system takes place for three basic reasons: specialized waveform simulator systems are costly, traditional test methodologies are analog based, and up until now there has been a lack of off-the-shelf, integrated vector signal generation capability above 6 GHz.

The simple and fundamental advantage of vector signal generation is that once the baseband signal has been digitized, we can do whatever we want with it. Within this paper we will discuss new approaches to test philosophy enabled by the vector signal generator. Waveform creation is the first building block of the simulation process and various methods exist to accomplish this task. Once created the waveforms can be manipulated to add impairments or to improve fidelity. New methodologies are proposed that increase repeatability and better simulate the operational environment of the device under test. The cost of test is reviewed to analyze, from a program management standpoint, the value of vector signal generation.

Creation of frequency agile and custom waveforms for advanced military communications and radar applications

Author(s): Jim Taber

Length: 50 min with demos

Abstract:

Radar and defense communication designers require signal simulators capable of generating custom, frequency agile pulses, with a high degree of signal fidelity. At the heart of these test systems is frequently an arbitrary waveform generator (AWG) capable of synthesizing clean, wide-bandwidth waveforms. Generating such signals can be a challenge because simulation tools often lack an easy to use interface to download and play waveforms directly to the AWG or the AWG lacks the bit resolution necessary to play the simulated waveforms. Realizing these real-world signals often requires the system designer to spend additional time and money creating their own custom AWG and programmatic interfaces

This paper describes an approach to creating custom waveforms using MATLAB® and the N6030A arbitrary waveform generator (AWG). The new N6030A is a dual-channel, differential output AWG operating at 1.25 GS/s clock frequency and 15 bits of vertical resolution. Considerations when building IF and IQ waveforms will be discussed along with an approach for IQ image correction. The paper also highlights requirements for waveform sequencing and system synchronization enabling users to create real-world signal scenarios.

Coherent Multi-Channel Systems Test Technology

Author(s): Kent K. Johnson

Length: 50 min with demos

Abstract:
Diversity antenna systems, phased array antennas, direction finding equipment and MIMO systems continue to grow in popularity. These coherent multi-channel systems offer capabilities that are simply unmatched by other technologies. This paper provides an overview on how these systems operate, their unique properties and the test challenges they present. Come learn about some of the different ways to combine antenna apertures, the common problems encountered and the latest in advanced test equipment solutions for the coherent multi-channel system.

Advance test techniques for Software Define Radio's

Author(s): David Del Sontro

Length: 50 min with demos

Abstract:

Advanced military radios are specialized in nature, creating challenges for engineers generating and demodulating the differing types of complex signals needed for radio design and test. Commercial-off-the-shelf tools are often not available and custom test set ups can be expensive and lack the needed flexibility for the multiple types of signals required for advanced wideband communication systems test. With the increase of commercially available programmable devices, the ability now exists to configure a set of hardware that can serve as a software defined instrument (SDI) suitable for the creation and analysis of modulated signals. This real-time set of hardware enables modulation and demodulation of wideband signals, thereby permitting the extraction (or insertion) of actual encoded data and protocol. This programmable hardware emulates the radio and is instrument grade traceable. With the addition of the proper hooks to program directly from modeling tools, such as Agilent Advance Design System (ADS) and MathWorks Simulink, the concepts of model-based measurements is now achievable for complex wideband systems.

Scalable Radar Target Generation and Analysis Systems

Author(s): Randal Burnette (Synergent Technologies)

Length: 50 min with demos

Abstract:
The evaluation of a radar system has typically required the development of custom test hardware. Often the custom test hardware rivals the complexity of the radar being tested. With the development of the microwave vector signal generator, wideband arbitrary waveform generator, and vector signal analyzer test equipment can be used to proto-type the basic building blocks of a multi-mode radar. The equipment can also be used as a target generator and jammer simulator to evaluate the response of the radar signal processor. Agilent provides bundled subsystems along with the software tools and expertise to integrate these building blocks into complete test solutions.

Digital Baseband and Digital IF--Signal Analysis and Signal Generation Techniques

Author(s): Benjamin Zarlingo, James Chen

Length: 50 min with demos

Abstract:
Modern radios and radar systems are increasingly making use of digital baseband signals and digital IF processing (DSP). These digital equivalents of previous analog systems promise improved efficiency, performance, and the flexibility to implement schemes such as software-defined radios.

Design and test of these systems is much easier with test equipment that can generate or analyze signals in either digital or analog form. Ideally, engineers can work throughout the radio block diagram, dealing with signals in whatever form they find them, using the same tools, algorithms, and displays whether the signal is in digital or analog form, or across an analog-digital transition. This paper will describe modern test equipment and techniques for efficient design and troubleshooting in this mixed-mode environment.

Future Proofing Your Automated Test Systems Using LAN-based Synthetic Instruments

Author(s): John Swanstrom

Length: 50 min with demos

Abstract:

Current trends in military automated test equipment (ATE) systems are requiring a significant reduction in the total cost of ownership, smaller size, and faster deployment of new test systems. Current ATE systems suffer from high support costs due to constant equipment discontinuance and the associated logistics footprint changes and test software revisions required to integrate replacement instruments. A new ATE approach is necessary to meet the military's needs. This paper will introduce Agilent's new LXI synthetic instrument architecture and show how these building blocks can be used to develop automated test systems that are smaller in size, achieve lower total cost of ownership, and are easily reconfigured. Information will be provided on synthetic instrument building blocks for automated test systems and the tradeoffs between various test system designs. By using synthetic instruments, significant reductions in future software support costs can be achieved thus future proofing your ATE systems and achieving lower overall cost of ownership

Advances in Converter Measurements

Author: David Ballo

Length: 50 min with demos

Abstract:

Frequency translating devices such as mixers and converters are at the core of all of today's high-frequency radar and communication systems. These devices present unique measurement challenges since input and output frequencies differ, requiring different measurement and calibration techniques than those used for linear devices such as filters and amplifiers. This paper explores how modern vector network analyzers employ advanced vector-error-correction techniques to make highly accurate magnitude, phase, and group delay measurements of frequency-translating devices. Other practical techniques for improving measurement accuracy will also be covered.

High Speed Spectral Survey Techniques for Frequency Monitoring and Technical Security Applications

Author(s): Chris Sutton and Larry Bennett – Agilent Technologies

Length: 50 min with demos

Abstract:
Managing and protecting the valuable asset of a frequency allocation in the RF spectrum requires the identification and cataloging of very small signals anywhere within a large frequency band. A common problem is that the noise floor of the measurement will obscure these interfering signals unless the resolution bandwidth is reduced dramatically. However, this excessive frequency resolution causes two additional problems: very slow measurement acquisition and mountains of measurement data.

This paper discusses the tools needed to hunt down those elusive low-level signals that can cause interference with communication systems or indicate security compromise. We will show how to establish a baseline environmental scan, detect new or hidden signals, and schedule automatic measurements using alarm-task triggering based on signal statistics. Learn about a new measurement solution that is optimized for speed and includes the data reduction tools required in these applications.

New techniques for increasing the POI in intercept and collection of LPI push-to-talk voice communications

Author(s): Jerry Stone – Agilent Technologies

Length: 50 min with demos

Abstract:

Traditional voice intercept systems rely on manual "spin & grin" techniques for locating voice signals in the dense RF spectrum. These manual techniques are not only tedious, but the limited scanning coverage results in a very low probability of intercept.

This paper describes a new system from Agilent Technologies, which automatically identifies and records voice signals in the VHF/UHF radio frequency band. Based on the Agilent E3238s Signals Development Platform, the system combines a wideband signal search sub-system, integrated energy detection and alarm sub-system, and multiple channels of specialized narrowband processing, all in low-cost portable package.

The wideband search sub-system provides high-speed, high-dynamic range spectral scanning over a 36 MHz bandwidth. The integrated energy detection and alarming sub-system identifies candidate voice transmissions in the wideband spectrum, and tasks the narrowband voice signal analysis. The narrowband voice processor uses multiple channels of digital-down-converters to obtain the narrowband signals of interest – then employs a *proprietary language- and speaker-independent voice processing algorithm* to confirm the signal contains voice. Confirmed voice signals can be recorded to disk, or can drive tasking of external devices via an integrated signal alarm system.

Initial deployments of these systems show conclusively that the automated voice activity detection system provides a robust, cost-effective solution - and dramatically increases the probability of intercept compared to traditional manual techniques.

RF Spectrum *Monitoring and Geolocation Techniques using Distributed Sensor Networks*

Author(s): Robert T. Cutler
Chief Technologist, Sensor Network Solutions
Agilent Technologies,Inc.
Everett, WA.

Length: 60 minutes

Abstract:

Today's RF environment is extremely challenging for those organizations that need to monitor the spectrum to detect, characterize and geolocate *signals of interest*. Whether for intelligence/surveillance or interference resolution purposes, many techniques currently in use today are significantly lagging target emitter technologies. Low power radios, frequency agile signals, severe multi-path effects, high frequency reuse and advanced modulation techniques limit the effectiveness of these solutions. Further, some emerging solutions today are radio service band specific and will not scale effectively to provide the broader spectrum coverage needed by many users.

Agilent Technologies is developing a new approach to the combined problem of signal detection, characterization and geolocation of RF emitters. This technique is based on a spatially distributed network of *software-defined RF sensors* interconnected by a network backhaul. These sensors will coherently monitor the spectrum providing advanced detection and geolocation of target emitters.

This presentation will highlight the pros and cons of a sensor network approach using time difference of arrival (TDA) techniques relative to some existing commercial solutions. Actual field test results achieved to date will be reviewed.